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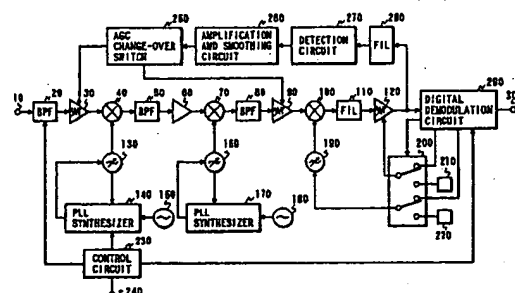
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(54) High definition tv signal receiver.

(57) To make it possible to receive a modulated signal which is obtained by suppressing a carrier signal such as a high definition TV signal which is digitally demodulated such as QAM (quadrature amplitude modulation), a receiver of the double super-heterodyne system having the first and second mixers 9 and 13 is a basic constitution. A band pass filter having a flatness in pass band and a small deviation of group delay which will prevent the demodulation of a high definition TV signal from degradation is used a first intermediate frequency filter 11. An SAW filter is used as a second intermediate frequency filter 16. The third mixer 28 for converting a second intermediate frequency signal to a third intermediate frequency signal in frequency is installed and the frequency of the third intermediate frequency signal to be converted is set to a value lower than the frequency of the second intermediate frequency signal. The demodulator 33 for a high definition TV signal is installed so as to demodulate a high definition TV signal included in the third intermediate frequency signal.

FIG. 1



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BACKGROUND OF THE INVENTION

The present invention relates to a receiver which can receive a high definition TV signal and more particularly to a high definition TV signal receiver which can receive a high definition TV signal which is compressed to a band width which is the same as that of a TV signal of the standard system such as the NTSC system and a TV signal of the standard system even when they are multiplexed and transmitted within the co-channel.

Furthermore, the present invention relates to a high definition TV signal receiver which can selectively receive a high definition TV signal and a standard TV signal and relates to a high definition TV signal receiver which can share and receive a high definition TV signal which is compressed to a band width which is the same as that of a TV signal of the standard system and a TV signal of the standard system (a TV signal of not only the NTSC system but also another standard system which is modulated in amplitude is included).

DESCRIPTION OF THE RELATED ART

As television broadcasting and CATV broadcasting have been expanded recently, broadcasting channels are being multiplexed. In correspondence with it, to reduce image interferences and reception interferences due to leakage of a local oscillation signal even at the time of multi-channel reception, a receiver of the double super-heterodyne system is used.

However, the aforementioned prior art is used to receive a TV signal of the standard system such as the NTSC system and reception of a signal which is digitally modulated such as a high definition TV signal is not taken into account. Multiplexing and transmission of a TV signal of the standard system and a high definition TV signal in the co-channel are neither taken into account.

SUMMARY OF THE INVENTION

An object of the present invention is to provide a high definition TV signal receiver which can selectively receive one of a TV signal of the standard system and a high definition TV signal.

To accomplish the above object, the present invention uses the double super-heterodyne system as a basic constitution so as to receive a high definition TV signal, uses a band pass filter having a flatness in pass band characteristics and a small deviation of group delay characteristics which prevent the demodulation of a high definition TV signal from degradation as a first intermediate frequency filter, uses a high definition TV signal filter (surface acoustic wave filter, etc.) as a second intermediate

frequency filter, installs a third mixer for converting a high definition TV signal to a third intermediate frequency signal, and installs a high definition TV signal demodulator in the demodulation section.

To share and receive a high definition TV signal and a TV signal of the standard system, the present invention uses the double super-heterodyne system as a basic constitution, uses a band pass filter having a flatness in pass band characteristics and a small deviation of group delay characteristics which prevent the demodulation of a high definition TV signal from degradation as a first intermediate frequency filter, uses a high definition TV signal filter and a filter (surface acoustic wave filter, etc.) for a TV signal of the standard system such as a TV signal of the NTSC system as a second intermediate frequency filter, installs a third mixer for converting a high definition TV signal to a third intermediate frequency signal, installs a high definition TV signal demodulator in the demodulation section, and an AM demodulator for a TV signal of the standard system in the demodulation section.

Furthermore, to share and receive a high definition TV signal and a TV signal of the standard system, the present invention uses the double super-heterodyne system as a basic constitution, uses a band pass filter having a flatness in pass band characteristics and a small deviation of group delay characteristics which prevent the demodulation of a high definition TV signal from degradation as a first intermediate frequency filter, uses a high definition TV signal filter as a second intermediate frequency filter, installs a third mixer for converting a high definition TV signal to a third intermediate frequency signal, and installs a common demodulator for a high definition TV signal and a TV signal of the standard system in the demodulation section.

The present invention having the aforementioned constitution can selectively select a TV signal of the standard system and a high definition TV signal even when they are multiplexed and transmitted in the co-channel or even when they are transmitted independently.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a block diagram showing the first embodiment of the high definition TV signal receiver of the present invention.

Fig. 2 is a block diagram showing the second embodiment of the high definition TV signal receiver of the present invention.

Fig. 3 is a block diagram showing the third embodiment of the high definition TV signal receiver of the present invention.

Fig. 4 is a block diagram showing the fourth embodiment of the high definition TV signal receiver of the present invention.

Fig. 5 is a block diagram showing the fifth embodiment of the high definition TV signal receiver of the present invention.

Fig. 6 is a block diagram showing the sixth embodiment of the high definition TV signal receiver of the present invention.

Fig. 7 is a block diagram showing the seventh embodiment of the high definition TV signal receiver of the present invention.

Fig. 8 is a block diagram showing the eighth embodiment of the high definition TV signal receiver of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The embodiments of the present invention will be explained hereunder with reference to the accompanying drawings. An example of a TV signal of the NTSC system (hereinafter referred to as just an NTSC signal) will be used for explanation as a TV signal of the standard system.

Fig. 1 is a block diagram showing the first embodiment of the high definition TV signal receiver of the present invention. Numeral 10 indicates a TV signal input terminal, 20 an input filter, 30 a variable gain amplifier, 40 a mixer, 50 an intermediate frequency filter, 60 an intermediate frequency amplifier, 70 a mixer, 80 an intermediate frequency filter, 90 an intermediate frequency variable gain amplifier, 100 a mixer, 110 an intermediate frequency filter, 120 an intermediate frequency variable gain amplifier, 130 a local oscillator, 140 a PLL synthesizer, 150 a standard oscillator, 160 a local oscillator, 170 a PLL synthesizer, 180 a standard oscillator, 190 a local oscillator, 200 a change-over switch, 210 and 220 fixed value generation circuits, 230 a control circuit, 240 a channel selection signal input terminal, 250 an AGC change-over switch, 260 an amplification and smoothing circuit, 270 a detection circuit, 280 a filter, 290 a high definition TV signal demodulator, and 300 a high definition TV signal output terminal.

In the drawing, the digitized high definition TV signal is compressed in data, digitally modulated by QAM (quadrature amplitude modulation), QPSK (quadrature phase shift keying), or OFDM (orthogonal frequency division multiplexing), and has a band width which is almost equal to that of an ordinary TV signal. This high definition TV signal is inputted from the input terminal 10 and divided into a VHF band and UHF band by the input filter 20 (furthermore, the VHF band may be divided into a low band, medium band, and high band) and only signals in the band including the desired channel

are extracted and supplied to the variable gain amplifier 30.

The input filter 20 is controlled in the control circuit 230 so as to become a suitable pass band by a channel selection signal which is inputted from the input terminal 240. The number of channels to be supplied to the variable gain amplifier 30 is reduced by the input filter 20. By doing this, mutual modulation interferences between input signals which are generated in the subsequent circuits can be reduced.

A signal whose band is restricted by the input filter 20 is amplified or attenuated to a suitable signal level by the variable gain amplitude 30 and then supplied to the mixer 40.

On the other hand, the local oscillator 130 is controlled by the control circuit 230 and the PLL synthesizer 140 so as to oscillate at the frequency corresponding to the desired channel by the channel selection signal which is inputted from the input terminal 240. The PLL synthesizer 140 compares an oscillation signal having a stable frequency from the standard oscillator 150 which is divided and an oscillation signal from the local oscillator 130 which is divided and controls the oscillation frequency of the local oscillator 130 so that the error thereof becomes zero. When the dividing ratio thereof is changed suitably by the control circuit 230, the local oscillator 130 can oscillate at the frequency corresponding to the desired channel.

The mixer 40 mixes an output signal of the variable gain amplifier 30 and a local oscillation signal from the local oscillator 130 and outputs a first intermediate frequency signal. The frequency of this first intermediate frequency signal is set to more than the upper limit of the terrestrial broadcasting band of an NTSC signal or the CATV broadcasting band so as to reduce image interferences and to prevent reception interferences due to leakage of a local oscillation signal. For example, in the frequency allocation in Japan and USA, the 960 MHz band, 1200 MHz band, 1700 MHz band, 2600 MHz band, or 3000 MHz band is used.

The intermediate frequency filter 50 extracts only the desired channel of this intermediate frequency signal and supplies it to the intermediate frequency amplifier 60. The intermediate frequency filter 50 is a band pass filter having a flatness in pass band characteristics and a small deviation of group delay characteristics which prevent the demodulation of a high definition TV signal from degradation and a dielectric resonant filter or a surface acoustic wave filter is used. The output signal of the intermediate frequency filter 50 is amplified by the intermediate frequency amplifier 60, supplied to the mixer 70, and mixed with a local oscillation signal from the local oscillator 160 so as to be switched to a second intermediate frequency sig-

nal.

The frequency of the second intermediate frequency signal is set to a frequency which is the same as that when a TV signal of the current standard system is received. Concretely, in USA, it is a 45 MHz band which is the same as that when an NTSC signal is received. In Japan, it is a 58 MHz band.

The local oscillator 160 is controlled by the PLL synthesizer circuit 170. The PLL synthesizer 140 compares an oscillation signal having a stable frequency from the standard oscillator 180 which is divided and an oscillation signal from the local oscillator 160 which is divided and controls the oscillation frequency of the local oscillator 160 so that the error thereof becomes zero.

For the second intermediate frequency signal, only the desired channel is extracted by the intermediate frequency filter 80 and the signal is amplified or attenuated by the intermediate frequency variable gain amplification circuit 90 so as to be set to the desired signal level and then inputted to the mixer 100.

The intermediate frequency filter 80 also requires a flatness in pass band and a small deviation of group delay which prevent the demodulation characteristics of a high definition TV signal from degradation and it is necessary to eliminate interferences from the neighboring channel, so that the intermediate frequency filter 80 consists of a surface acoustic wave filter or others so as to pass only the band of the desired receiving channel.

The mixer 100 mixes an output signal of the intermediate frequency amplifier 90 and a local oscillation signal from the local oscillator 190 and outputs a third intermediate frequency signal. The third intermediate frequency signal is lower in frequency than the second intermediate frequency signal and when the frequency almost coincides with the symbol rate of a high definition TV signal, the demodulation circuit is simplified. As described later, when the frequency band is set to a frequency band in which the FM modulation necessary to write on a recording medium such as a magnetic tape or optical disk can be easily executed, the write circuit is simplified. When the frequency of the third intermediate frequency signal is set low, various signal processing can be executed easily by using an operation amplifier which can process an analog signal with high precision as an amplifier installed on the subsequent stage of the mixer 100 or by converting an analog signal to a digital signal.

The third intermediate frequency signal is supplied to the intermediate frequency filter 110 and only a signal of the desired channel is extracted, amplified or attenuated by the intermediate frequency variable gain amplifier 120 so as to be set

to the desired signal level, and then demodulated to a high definition TV signal by the high definition TV signal demodulator 290 and outputted from the output terminal 300. An oscillation frequency fine tuning signal of the local oscillator 190 and a gain control signal of the intermediate frequency variable gain amplifier 120 are outputted from the high definition TV signal demodulator 290.

An analog digital converter, which is not shown in the drawing, for converting an analog signal to a digital signal between the intermediate frequency variable gain amplifier 120 and the high definition TV signal demodulator 290 may be installed. In this case, when the level of an input signal of the analog digital converter is changed, the quantization error is changed and the normal operation of the demodulator may be disturbed. However, since the intermediate frequency variable gain amplifier 120 is installed, the gain is finely tuned so as to keep the amplitude level unchanged.

When the power is turned on or the channel is changed, the operation of the high definition TV signal demodulator 290 is not stable, so that an oscillation frequency fine tuning signal of the local oscillator 190 and a gain control signal of the intermediate frequency variable gain amplifier 120 may not be as specified. Therefore, these control signals are interrupted by the change-over switch 210 and in place of it, an output signal of the fixed value generation circuit 210 becomes a gain control signal of the intermediate frequency variable gain amplifier 120 and an output signal of the fixed value generation circuit 220 becomes a frequency fine tuning signal of the local oscillator 190.

When the channel is changed, the control circuit 230 sends a signal indicating that the channel is changed to the high definition TV signal demodulator 290. By doing this, the high definition TV signal demodulator 290 enters the initial state and the demodulation can start smoothly.

A high definition TV signal outputted from the output terminal 300 is subjected to data decompression processing, and an image and voice are processed variously, and the signal is displayed on a display unit which is not shown in the drawing.

An output signal of the intermediate frequency variable gain amplifier 120 is also supplied to the filter 280 and only the desired band is extracted, detected by the detection circuit 270, and subjected to suitable amplification and smoothing processing by the amplification and smoothing circuit 260 so as to form a gain control signal. This gain control signal is supplied to one of the variable gain amplifier 30 and the intermediate frequency variable gain amplifier 90 as a gain control signal by the AGC change-over switch 250.

When the signal level of the third intermediate frequency signal from the intermediate frequency

variable gain amplifier 120 is increased, a gain control signal which is obtained by the filter 280, the detection circuit 270, and the amplification and smoothing circuit 260 is supplied to the intermediate frequency variable gain amplifier 90 by the AGC change-over switch 250. After the gain attenuation amount of the intermediate frequency variable gain amplifier 90 is maximized, the AGC change-over switch 250 supplies the gain control signal to the variable gain amplifier 30.

When the signal level of the third intermediate frequency signal is decreased, the gain control signal is supplied to the variable gain amplifier 30 by the AGC change-over switch 250. After the gain of the variable gain amplifier 30 is maximized, this gain control signal is supplied to the intermediate frequency variable gain amplifier 90 and the gain of the intermediate frequency variable gain amplifier 90 is increased.

By controlling the gain by the variable gain amplifier on the subsequent stage, the noise figure of the whole receiver can be prevented from degradation.

The gain control signal to the variable gain amplifier 30 is detected at a comparatively long time constant, and the gain control signal to the intermediate frequency variable gain amplifier 90 is set to a comparatively short time constant, and when the signal level is changed in a short period like a flutter by an airplane, the intermediate frequency variable gain amplifier 90 on the subsequent stage follows the change thereof.

The pass band of the filter 280 is set in the section in which the video carrier on a high level of an NTSC signal which may be transmitted through the co-channel is excluded. By doing this, when a high definition TV signal is received, the gain change of the receiver due to an NTSC signal which is transmitted through the co-channel is reduced. A band pass filter or notch filter is used for the filter 280.

For a high definition TV signal, a case that it is transmitted through the co-channel as that of an NTSC signal is taken into account. To avoid interferences from the NTSC signal, a spectrum of high definition TV signal is not arranged in the neighborhood of a video and an audio carrier and a chromatic subcarrier on a high level of the NTSC signal. Therefore, it is necessary to install a notch filter for eliminating the carrier and subcarrier of the NTSC signal in the high definition TV signal demodulator 290.

As mentioned above, in this embodiment, to pass a high definition TV signal through the intermediate frequency filters 50 and 80, a band pass filter having a flatness in pass band and a small deviation of group delay which prevent the demodulation characteristics of the high definition TV

signal from degradation is used.

When the second intermediate frequency signal is converted to the third intermediate frequency signal having a lower frequency by the mixer 100, various signal processing can be executed easily by using an operation amplifier which can process an analog signal with high precision on the subsequent stage of the mixer 100 or by converting an analog signal to a digital signal.

Furthermore, by using the filter 280 for eliminating the carrier part on a high level of a TV signal of the standard system such as an NTSC signal which may be transmitted through the co-channel when a gain control signal is detected, even when the two signals are transmitted through the co-channel, the gain control error can be reduced and the desired high definition TV signal can be demodulated.

By doing this, even when a TV signal of the standard system such as an NTSC signal and a high definition TV signal are transmitted through the co-channel, the cross modulation by the two signals can be reduced and the high definition TV signal can be demodulated at a low error rate.

Fig. 2 is a block diagram showing the second embodiment of the high definition TV signal receiver of the present invention. The same numeral is assigned to each part corresponding to Fig. 1 so as to omit duplicate explanation. In this embodiment, the oscillation frequency of the local oscillator 160 is finely tuned by an oscillation frequency fine tuning signal from the high definition TV signal demodulator 290.

Fig. 3 is a block diagram showing the third embodiment of the high definition TV signal receiver of the present invention. Numeral 131 indicates a local oscillator, 141 a mixer, 151 a local oscillator, 161 a PLL synthesizer, and 171 a standard oscillator. The same numeral is assigned to each part corresponding to Fig. 1 so as to omit duplicate explanation.

In the drawing, the first local oscillation signal from the local oscillator 131 and the second oscillation signal from the local oscillator 151 are mixed by the mixer 141 and the synthesizer compares a signal having the differential frequency thereof which is divided and an oscillation signal having a stable frequency from the standard oscillator 171 which is divided and controls the oscillation frequency of the local oscillator 131 by the PLL synthesizer 161 so that the error thereof becomes zero.

The local oscillator 131 is controlled by the control circuit 230 and the PLL synthesizer circuit 161 so as to oscillate at the frequency corresponding to the desired channel by a channel selection signal inputted from the input terminal 240. When the dividing ratio in the PLL synthesizer circuit 161

is suitably changed by the control circuit 230, the local oscillator 131 can oscillate at the frequency corresponding to the desired channel.

In this embodiment, in addition to the effect obtained in the first embodiment shown in Fig. 1, it is used that the difference between the frequency of the first local oscillation signal and the frequency of the second local oscillation signal is kept constant in the co-channel and the numbers of PLL synthesizers and standard oscillators can be reduced lower than those in the first embodiment.

Fig. 4 is a block diagram showing the fourth embodiment of the high definition TV signal receiver of the present invention. The same numeral is assigned to each part corresponding to Fig. 1 so as to omit duplicate explanation. In this embodiment, the oscillation frequency of the local oscillator 151 is finely tuned by an oscillation frequency fine tuning signal from the high definition TV signal demodulator 290.

Fig. 5 is a block diagram showing the fifth embodiment of the high definition TV signal receiver of the present invention. Numeral 310 indicates a recording medium and peripheral equipment thereof. The same numeral is assigned to each part corresponding to Fig. 1 so as to omit duplicate explanation.

In the drawing, the recording medium and peripheral equipment thereof 310 consists of a read/write magnetic disk or magnetic optical disk which can record a high definition TV signal or a phase conversion optical disk and a drive circuit therefor.

For current standard TV signals such as NTSC signals, image and sound recorders such as video tape recorders are now widespread and a program which is being viewed or a program which is not being viewed can be recorded while viewing the program and automatic recording can be executed by setting the time. Such recording is to partially change the base band signal of a standard TV signal such as an NTSC signal, modulate the frequency, and record it on a magnetic tape. In this case, the signal is subjected to FM modulation at the carrier frequency which is decided from the relative speed between the magnetic tape and magnetic head and the cap length of the magnetic head. Therefore, when the frequency of the third intermediate frequency coincides with a frequency which can be easily modulated, the signal processing unit which is necessary for writing can be simplified. In this case, an FM modulator is installed in the input section of the recording medium and peripheral equipment thereof 310 and an FM demodulator is installed in the output section thereof.

A high definition TV signal has a large amount of information compared with a standard TV signal.

However, the frequency band width of the base band signal of the high definition TV signal is the same as that of the standard TV signal due to highly efficient image coding and entropy coding. Therefore, when the high definition TV signal is recorded before it is demodulated to digital data, the efficiency which is almost equal to that of the standard TV signal can be obtained from a viewpoint of storage capacity and images can be recorded for many hours.

When the aforementioned analog image recording mode is added to a high definition TV signal image recorder so as to record images for many hours in addition to the digital image recording mode for recording digital information as it is, it is convenient to recording of images during absence. In the case of analog recording, image degradation may be caused by a temperature change or a change with time of a magnetic tape, magnetic optical disk, or phase conversion optical disk. However, a high definition TV signal is digital information, so that it can be corrected by the error correction technique and the image quality which is equivalent to that of the digital image recording mode can be obtained.

Fig. 6 is a block diagram showing the sixth embodiment of the high definition TV signal receiver of the present invention. Numeral 31 indicates a variable attenuator, 32 an amplifier, 33 a variable attenuator, and 251 an AGC change-over switch. The same numeral is assigned to each part corresponding to Fig. 1.

In the drawing, a TV signal inputted from the input terminal 10 is supplied to the input filter 20 and the band including the desired channel is extracted. An output signal of this input filter 20 is suitably amplified or attenuated by the variable attenuator 31, the amplifier 32, and the variable attenuator 33 and inputted to the mixer 40.

When the level of the input signal is increased, the AGC change-over switch 251 switches and controls a gain control signal from the amplification and smoothing circuit 260 so that the gain attenuation operation starts from the intermediate frequency variable gain amplifier 90 in correspondence with it, and the variable attenuator 33 starts attenuation by leaving the attenuation amount for corresponding to the level change such as the aforementioned flutter, and the variable attenuator 31 starts attenuation at the point of time that the attenuation amount is maximized. When the input level is decreased, the AGC change-over switch 251 switches and controls the gain control signal so that the attenuation amount of the variable attenuator 31 is decreased in correspondence with it, and next the attenuation amount of the variable attenuator 33 is decreased, and finally the gain of the intermediate frequency variable gain amplifier

90 is increased.

When the AGC change-over switch 251 is operated as mentioned above, the noise figure of the whole receiver can be prevented from degradation. At the time of gain attenuation, the degradation of the noise figure can be reduced lower than that in the first embodiment shown in Fig. 1.

Since the variable attenuator is divided and each is delayed and operated, the sensitivity of gain control amount to the AGC voltage can be reduced and a stable AGC operation can be obtained.

Furthermore, when the variable attenuator 31 is installed on the preceding stage of the amplifier 32, even when a TV signal on the maximum input level is inputted to the input terminal 10, mutual modulation interferences and cross modulation interferences can be reduced.

Fig. 7 is a block diagram showing the seventh embodiment of the high definition TV signal receiver of the present invention. Numeral 81 indicates an NTSC signal intermediate frequency filter, 91 an NTSC signal intermediate frequency variable gain amplifier, 291 an NTSC signal demodulator, 320 a change-over switch, and 330 an NTSC signal output terminal. The same numeral is assigned to each part corresponding to Fig. 1.

In this embodiment, an NTSC signal and a high definition TV signal can be selectively received.

Namely, in Fig. 7, even when an input TV signal from the input terminal 10 is an NTSC signal which is modulated in amplitude, or a high definition TV signal, or a signal in which an NTSC signal which is modulated in amplitude and a high definition TV signal are multiplexed through the co-channel, according to the channel selected by a viewer, when the channel is an NTSC signal, it is demodulated by the NTSC signal demodulator 291 and outputted from the NTSC signal output terminal 330. When the selected channel is a high definition TV signal, it is demodulated by the high definition TV signal demodulator 290 and outputted from the high definition TV signal output terminal 300.

When a signal in which an NTSC signal which is modulated in amplitude and a high definition TV signal are multiplexed through the co-channel is inputted, it is demodulated by the high definition TV signal demodulator 290 and outputted from the high definition TV signal output terminal 300. When the high definition TV signal cannot be received due to the Cliff effect in this case, the NTSC signal in the cochannel is automatically demodulated by the NTSC signal demodulator 291 and outputted from the NTSC signal output terminal 330.

Therefore, the intermediate frequency filter 50 is shared by a high definition TV signal and an NTSC signal and a band pass filter having a flat-

ness in pass band and a small deviation of group delay which prevent the demodulation characteristics of a high definition TV signal from degradation is used.

The second intermediate frequency signal is branched by the reception change-over switch 320 according to the high definition TV signal or the NTSC signal and supplied to the high definition TV signal intermediate frequency filter 80 which consists of an SAW filter or others or the NTSC signal intermediate frequency filter 81 and only the band of the desired receiving channel passes.

When a high definition TV signal is received, it is demodulated by an operation which is the same as that in the embodiment shown in Fig. 1.

On the other hand, when an NTSC signal is received, the second intermediate frequency signal is amplified by the NTSC signal intermediate frequency variable gain amplifier 91 and supplied to the NTSC signal demodulator 291 so as to be demodulated to an NTSC signal. This NTSC signal consists of a video and audio signals of the base band and outputted from the NTSC signal output terminal 330.

When a high definition TV signal is received, the change-over switch 320 is switched to the high definition TV signal receiving side, and the third intermediate frequency signal is branched in the same way as with the embodiment shown in Fig. 1, and only the desired band in the third intermediate frequency signal is extracted by the filter 280, and the signal level thereof is detected by the detection circuit 270 and suitably amplified and smoothed by the amplification and smoothing circuit 260 so as to form a gain control signal. This gain control signal is supplied to the variable gain amplifier 30 or the variable gain amplifier 90 via the AGC change-over switch 250.

When an NTSC signal is received, the change-over switch 320 is switched to the NTSC signal receiving side and a gain control signal which is generated in the NTSC signal demodulator 291 is supplied to the variable gain amplifier 30 or the variable gain amplifier 90 via the AGC change-over switch 250.

When a high definition TV signal is received, an oscillation frequency fine tuning signal is supplied to the local oscillator 190 from the high definition TV signal demodulator 290. However, when an NTSC signal is received, a frequency fine tuning signal is supplied to the control circuit 230 from the NTSC signal demodulator 291 and by doing this, the control circuit 230 controls so as to finely tune the oscillation frequency of the local oscillator 160.

To reduce the power consumption, it is possible to supply power only to one of the high definition TV signal demodulator 290 and the NTSC signal demodulator 291 according to the received

signal.

As explained above, in this embodiment, not only a high definition TV signal but also an NTSC signal can be received and the scale can be reduced by allowing these signals to share a part of the circuit.

Fig. 8 is a block diagram showing the eighth embodiment of the high definition TV signal receiver of the present invention. Numeral 292 indicates a common demodulation circuit of a high definition TV signal and an NTSC signal, 301 an NTSC signal output terminal, and 321 a change-over switch. The same numeral is assigned to each part corresponding to Fig. 1.

In this embodiment, an NTSC signal and a high definition TV signal can be selectively received in the same way as with the embodiment shown in Fig. 7.

When a high definition TV signal is received in Fig. 8, the change-over switch 321 is switched to the high definition TV signal receiving side. By doing this, the constitution becomes equal to that in the first embodiment shown in Fig. 1 and the same receiving operation is performed.

When an NTSC signal is received, the change-over switch 321 is switched to the NTSC signal receiving side. The intermediate frequency 80 is for a high definition TV signal and the NTSC signal intermediate frequency filter 81 having a special frequency characteristics as shown in the embodiments in Figs. 7 and 8 is not used. Therefore, the embodiment is not suited to handling of an AM modulation signal of the vestigial side-band system such as an NTSC signal.

When an NTSC signal is received, the common demodulation circuit 292 of a high definition TV signal and an NTSC signal generates a base band signal of the NTSC signal using a digital filter. For that purpose, by sharing the digital signal processing operation circuit and memory which are installed for demodulation, data decompression, and image processing of a high definition TV signal partially, the circuit scale can be reduced. This digital filter is a band pass filter showing a frequency characteristics which is the same as that of the NTSC signal intermediate frequency filter 81 but the center frequency is different from each other.

When a signal in which an NTSC signal and a high definition TV signal are multiplexed through the co-channel is received, the change-over switch 321 is switched to the high definition TV signal receiving side and the same receiving operation as that in the first embodiment shown in Fig. 1 is performed. When the high definition TV signal cannot be received due to the Cliff effect, the change-over switch 321 is changed to the NTSC signal receiving side so as to automatically receive the

NTSC signal in the co-channel.

By doing this, when broadcasting by a high definition TV signal is exactly equal in content to broadcasting by an NTSC signal through the co-channel, even when the high definition TV signal cannot be received, the program during viewing can be continued with pleasure without stopping.

In this case, when the screen frame by the high definition TV signal is perfectly synchronized with the screen frame by the NTSC signal and voice is continued, it is more convenient. Furthermore, in this case, when the horizontal and vertical resolutions of the NTSC signal are made equivalent to those of the high definition TV signal by performing the interpolation processing, the unpleasant feeling when a signal is switched can be reduced.

When it is decided whether there is an error between the screen frame by a high definition signal and the screen frame by an NTSC signal on the broadcasting station side or not or when any signal for synchronizing the screens is added from the broadcasting station side, by delaying one of the signals for the error, for example, by the memory, they can be synchronized with each other.

When no consideration is given to the aforementioned interframe error by the broadcasting station side, image comparison imposes an extremely heavy burden on the hardware, so that voice of a high definition TV signal and voice of an NTSC TV signal are compared with each other and the magnitude of frame error is calculated. For this calculation, not only voice but also the vertical synchronizing signal of the high definition TV signal and NTSC signal are used. Namely, by using the vertical synchronizing signal, the voice amplitude for each field (or each frame) or the spectrum after high speed Fourier conversion is compared between the high definition TV signal and NTSC signal and the fields (frames) having the greatest correlation are inferred as the same field (frame). By adding the difference in processing time between a high definition TV signal and an NTSC signal in a television set as a parameter beforehand, the number of fields (frames) to be compared is decreased and a result can be inferred more rapidly. This processing may be performed once when the channel is switched.

When voice is continued as mentioned above, a high definition TV signal and an NTSC signal can be synchronized with each other.

As explained above, in this embodiment, not only a high definition TV signal but also an NTSC signal can be received. Furthermore, when a high definition TV signal and an NTSC signal are multiplexed through the co-channel, even when the high definition TV signal becomes unreceivable, a function for automatically receiving the NTSC sig-

nal can be added.

When an NTSC signal is digitally demodulated and digitally subjected to image and voice processing, almost all the circuits can be shared by a high definition TV signal and an NTSC signal, and the circuit scale can be reduced substantially and can be made adjustment-free, and a standard TV signal (the PAL system or SECAM system) other than an NTSC signal can be processed by changing the software without adding or changing the hardware.

Furthermore, even when the conventional NTSC signal software resources (video of a movie, a product created by an individual using a video movie, etc.) are incorporated into a computer and any processing is added, an NTSC signal is handled as a digital signal in a television set, so that it is possible only by installing any output terminal (an SCSI interface, etc.).

The effects shown in the embodiments in Figs. 2, 3, and 4 can be added to each of the embodiments shown in Figs. 5, 6, 7, and 8. Furthermore, the effect shown in the embodiment in Fig. 6 can be added to each of the embodiments shown in Figs. 7, and 8.

As explained above, according to the present invention, when the first intermediate frequency filter is shared by a TV signal of the standard system and a high definition TV signal and the second intermediate frequency filter and demodulator are installed in the TV signal of the standard system and high definition TV signal individually, both of the TV signal of the standard system and high definition TV signal can be selectively received, and also the second mixer of the double super-heterodyne system can be shared by these TV signals, and the circuit scale can be reduced.

According to the present invention, when a high definition TV signal received is converted to the third intermediate frequency signal with a frequency lower than that of the second intermediate frequency signal by the third mixer, various signal processing can be executed easily by using an operation amplifier which can process an analog signal with high precision as an amplifier installed on the subsequent stage of the third mixer or by converting an analog signal to a digital signal. Even when a TV signal of the standard system and a high definition TV signal are multiplexed and transmitted through the co-channel, the cross modulation by these TV signals can be reduced and hence a high definition TV signal at a low error rate can be demodulated. Furthermore, according to the present invention, when a high definition TV signal is converted to the aforementioned third intermediate frequency signal, the frequency of signals handled by the high definition TV signal demodulator is reduced, so that the circuit constitution is simplified.

Furthermore, according to the present invention, when a TV signal of the standard type is digitally demodulated, a receiver shared by a small amount of general purpose high definition TV signals and TV signals of the standard system of the analog circuit can be configured. When a TV signal of the standard system and a high definition TV signal are multiplexed and transmitted through the co-channel in this case, even when the high definition TV signal becomes unreceivable, the receiver can be automatically switched so as to receive the TV signal of the standard system.

To detect the gain control signal of the first variable gain amplifier or the second intermediate frequency variable gain amplifier, when a TV signal of the standard system and a high definition TV signal are multiplexed and transmitted through the co-channel, by eliminating the carrier part with high energy in the TV signal of the standard system by a filter, an error operation of gain control by the TV signal of the standard system can be avoided when a high definition TV signal is received and the high definition TV signal can be demodulated satisfactorily.

Claims

1. A high definition TV signal receiver comprising:
 - an input filter for extracting a signal of the band including the desired signal from input radio frequency signals;
 - a radio frequency amplifier for amplifying or attenuating an output signal of said input filter;
 - a first local oscillator for outputting a first local oscillation signal at the oscillation frequency corresponding to the channel selection information;
 - a first frequency converter for converting said desired signal which is an output signal of said radio frequency amplifier to a first intermediate frequency signal by said first local oscillation signal;
 - a first intermediate frequency filter for extracting said first intermediate frequency signal from an output signal of said first frequency converter;
 - a first intermediate frequency amplifier for amplifying said first intermediate frequency signal;
 - a second local oscillator for outputting a second local oscillation signal;
 - a second frequency converter for converting said first intermediate frequency signal to a second intermediate frequency signal by said second local oscillation signal;
 - a second intermediate frequency filter for extracting only said second intermediate fre-

quency signal from an output signal of said second frequency converter;

a second intermediate frequency amplifier for amplifying or attenuating said second intermediate frequency signal;

a third local oscillator for outputting a third local oscillation signal;

a third frequency converter for converting said second intermediate frequency signal from said third local oscillator to a third intermediate frequency signal by said third local oscillation signal;

a third intermediate frequency filter for extracting only said third intermediate frequency signal from an output signal of said third frequency converter;

a third intermediate frequency amplifier for amplifying said third intermediate frequency signal;

a first demodulator for demodulating said third intermediate frequency signal and also for generating an AGC voltage for finely tuning the oscillation frequency of said third or second local oscillator and an AGC voltage for controlling the amplification degree of said intermediate frequency amplifier;

a filter having a frequency characteristics for reducing the frequency component, which is equal to the carrier component in a TV signal of the standard system, of said third intermediate frequency signal which is outputted and supplied from said third intermediate frequency amplifier;

a detector for detecting an output signal from said filter; and

a smoothing amplifier for smoothing an output signal of said detector and amplifying it to the desired voltage, wherein when said input radio frequency signal is a high definition TV signal having an occupied band width which is the same as that of a TV signal of the standard system, an output signal of said smoothing amplifier is a gain control signal of said radio frequency amplifier and said second intermediate frequency amplifier.

2. A high definition TV signal receiver according to Claim 1, wherein said receiver comprises:

a switching unit for branching said second intermediate frequency signal from said second frequency converter when said input radio frequency signal is said high definition TV signal and when it is a TV signal of the standard system and for supplying said second intermediate frequency signal to said second intermediate frequency filter when said input radio frequency signal is said high definition TV signal;

a fourth intermediate frequency filter for extracting only said second intermediate frequency signal which is supplied from said second frequency converter when said input radio frequency signal is a TV signal of the standard system;

a fourth intermediate frequency amplifier for amplifying said second intermediate frequency signal from said fourth intermediate frequency filter; and

a second demodulator for demodulating said second intermediate frequency signal from said fourth intermediate frequency amplifier and for outputting an AGC voltage for finely tuning the oscillation frequency of said second local oscillator and an AGC voltage for controlling the amplification degree of said radio frequency amplifier and said fourth intermediate frequency amplifier.

3. A high definition TV signal receiver according to Claim 2, wherein said receiver comprises means for setting said AGC voltage from said first demodulator to a control signal for the amplification degree of said third intermediate frequency amplifier when said input radio frequency signal is a high definition TV signal and for switching said AGC voltage from said second demodulator as a control signal for the amplification degree of said radio frequency amplifier and said fourth intermediate frequency amplifier when said input radio frequency signal is a TV signal of the standard system.

4. A high definition TV signal receiver according to Claim 1, 2, or 3 wherein said receiver comprises:

a fourth frequency converter for forming a signal at the differential frequency between said first local oscillation signal and said second local oscillation signal; and

means for controlling the oscillation frequency of said first local oscillator so as to keep said differential frequency constant by using the PLL circuit from said channel selection information.

5. A high definition TV signal receiver according to Claim 1, wherein said first demodulator demodulates a high definition TV signal when said input radio frequency signal is a high definition TV signal; demodulates a TV signal of the standard system by using a digital filter when said input radio frequency signal is a TV signal of the standard system, and outputs an AGC voltage for gain control of said radio frequency amplifier and said second intermediate frequency amplifier even when said input

radio frequency signal is a TV signal of the standard system and the section from the input terminal of said input radio frequency signal to said third intermediate frequency amplifier for amplifying said third intermediate frequency signal is shared by said input radio frequency signal of a high definition TV signal and said input radio frequency signal of a TV signal of the standard system.

6. A high definition TV signal receiver according to Claim 1, 2, 3, 4, or 5 wherein said first intermediate frequency filter consists of a dielectric resonant filter.
7. A high definition TV signal receiver according to Claim 1, 2, 3, 4, or 5 wherein said second intermediate frequency filter for a high definition TV signal consists of an SAW filter.

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FIG. 1

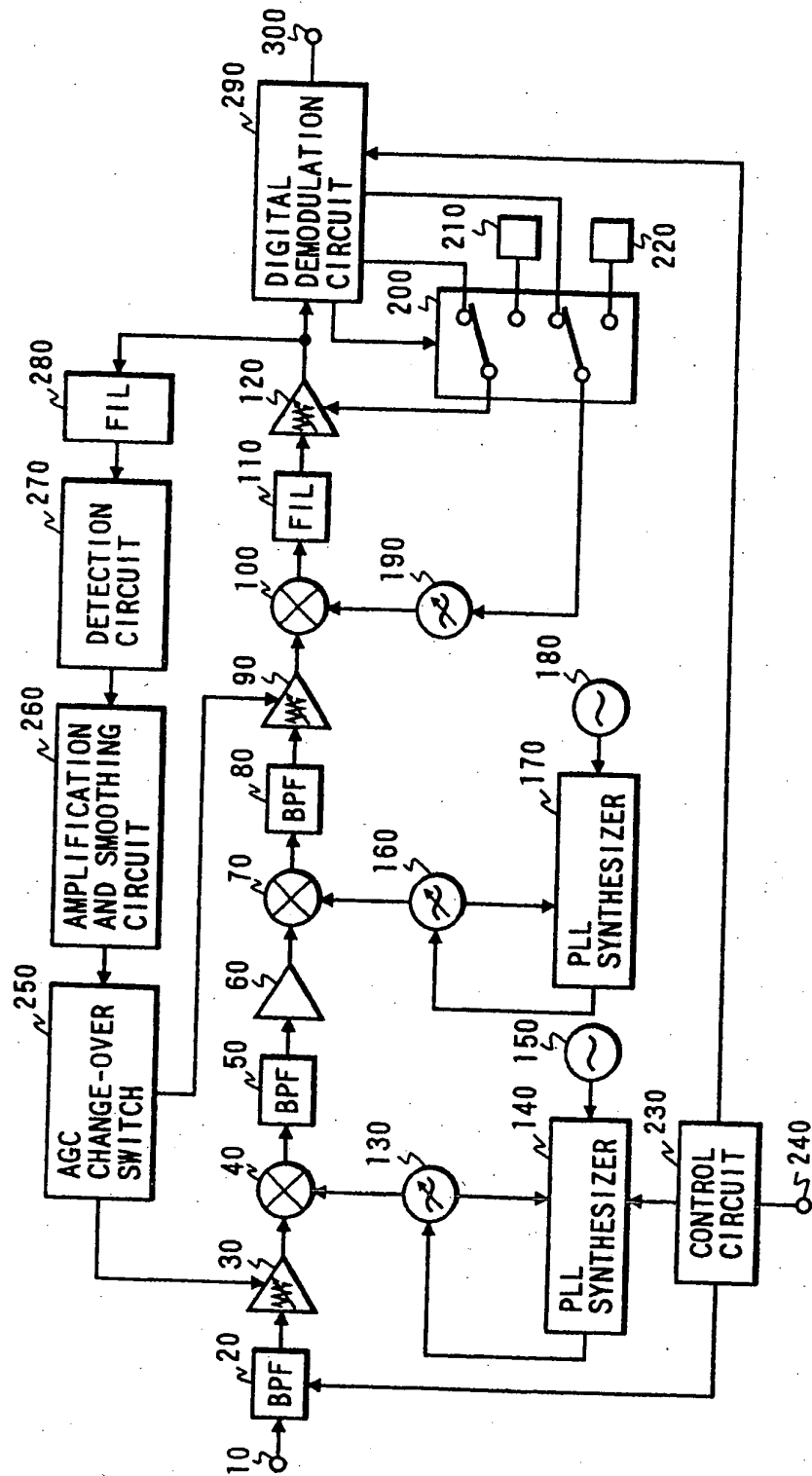


FIG. 2

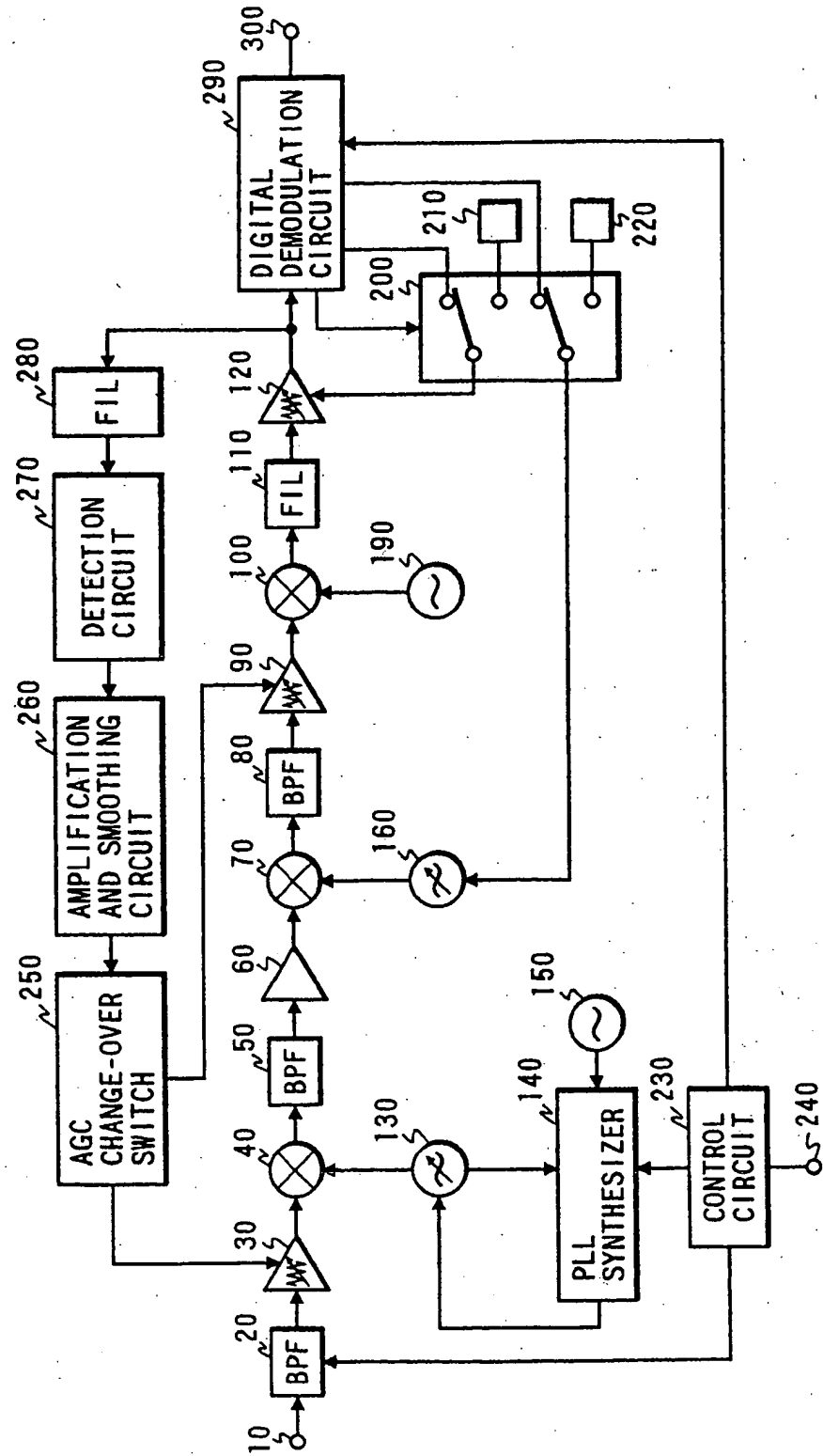


FIG. 3

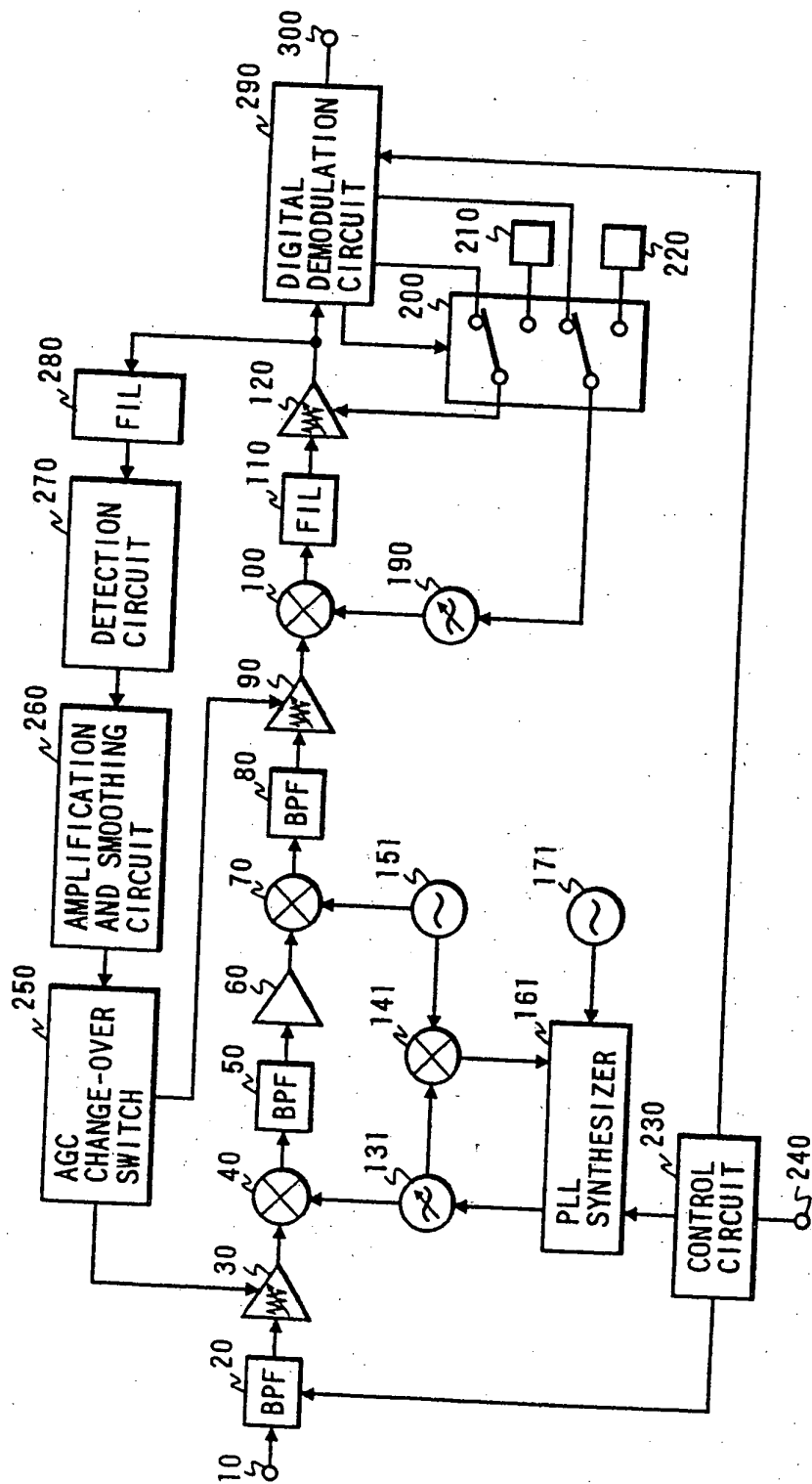


FIG. 4

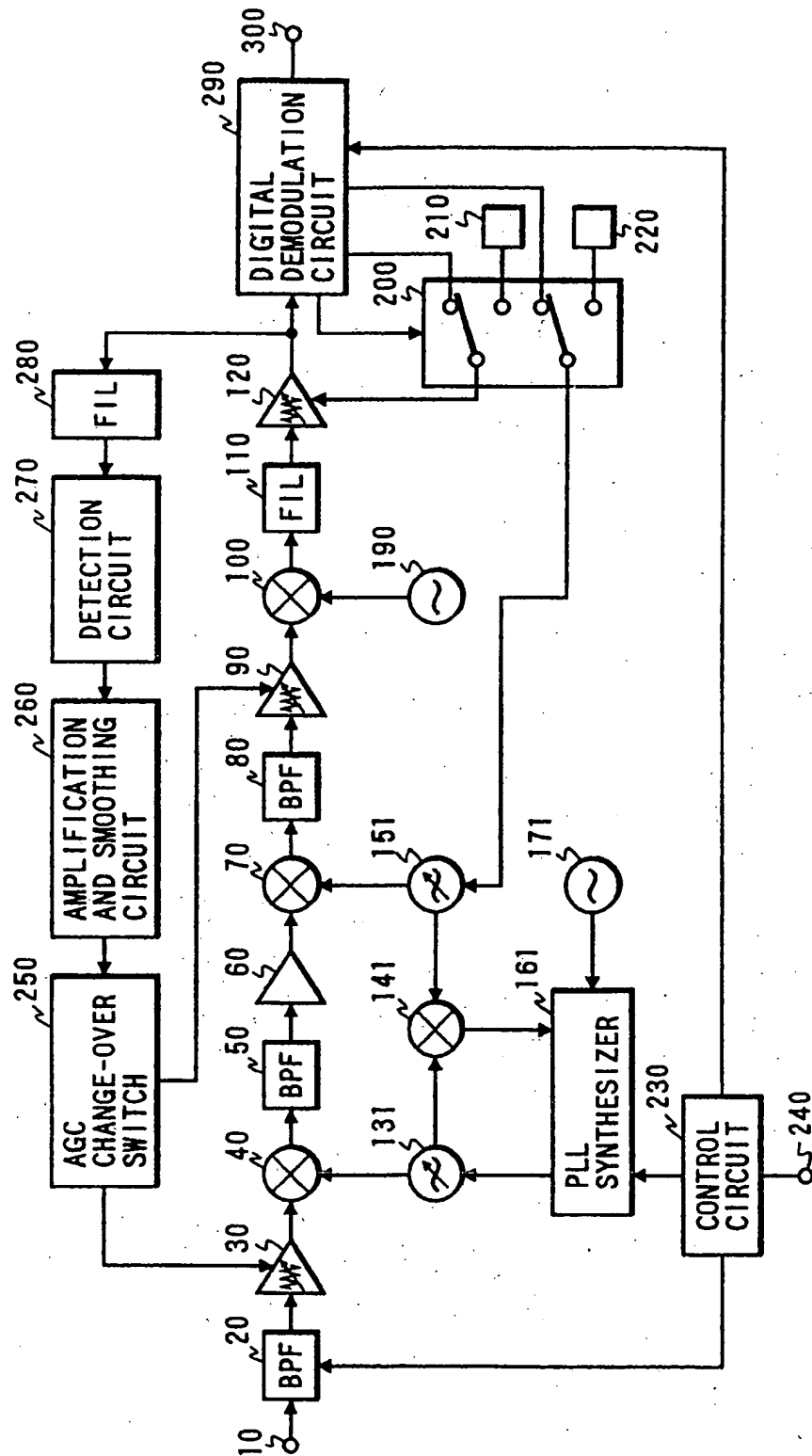


FIG. 5

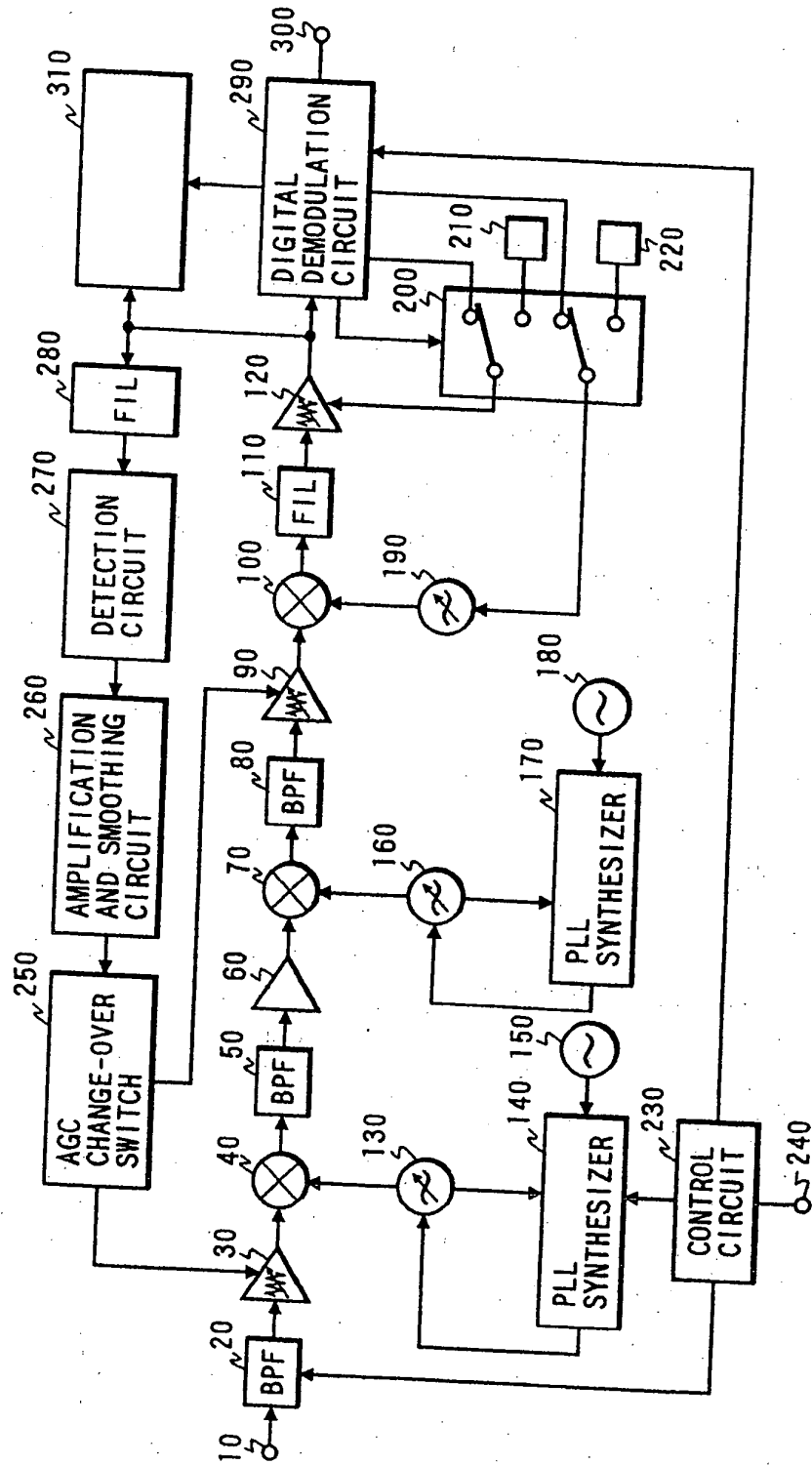


FIG. 6

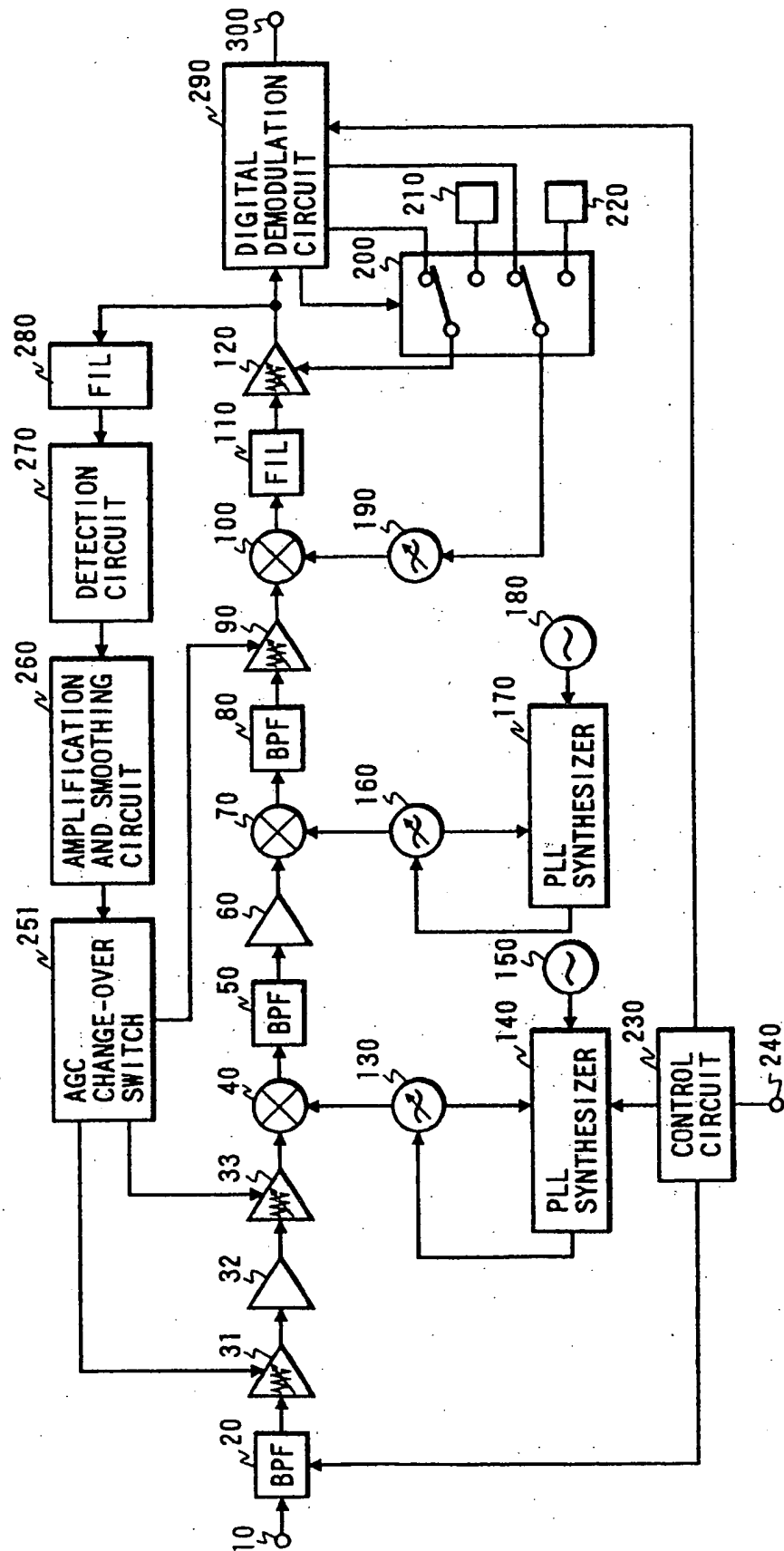


FIG. 7

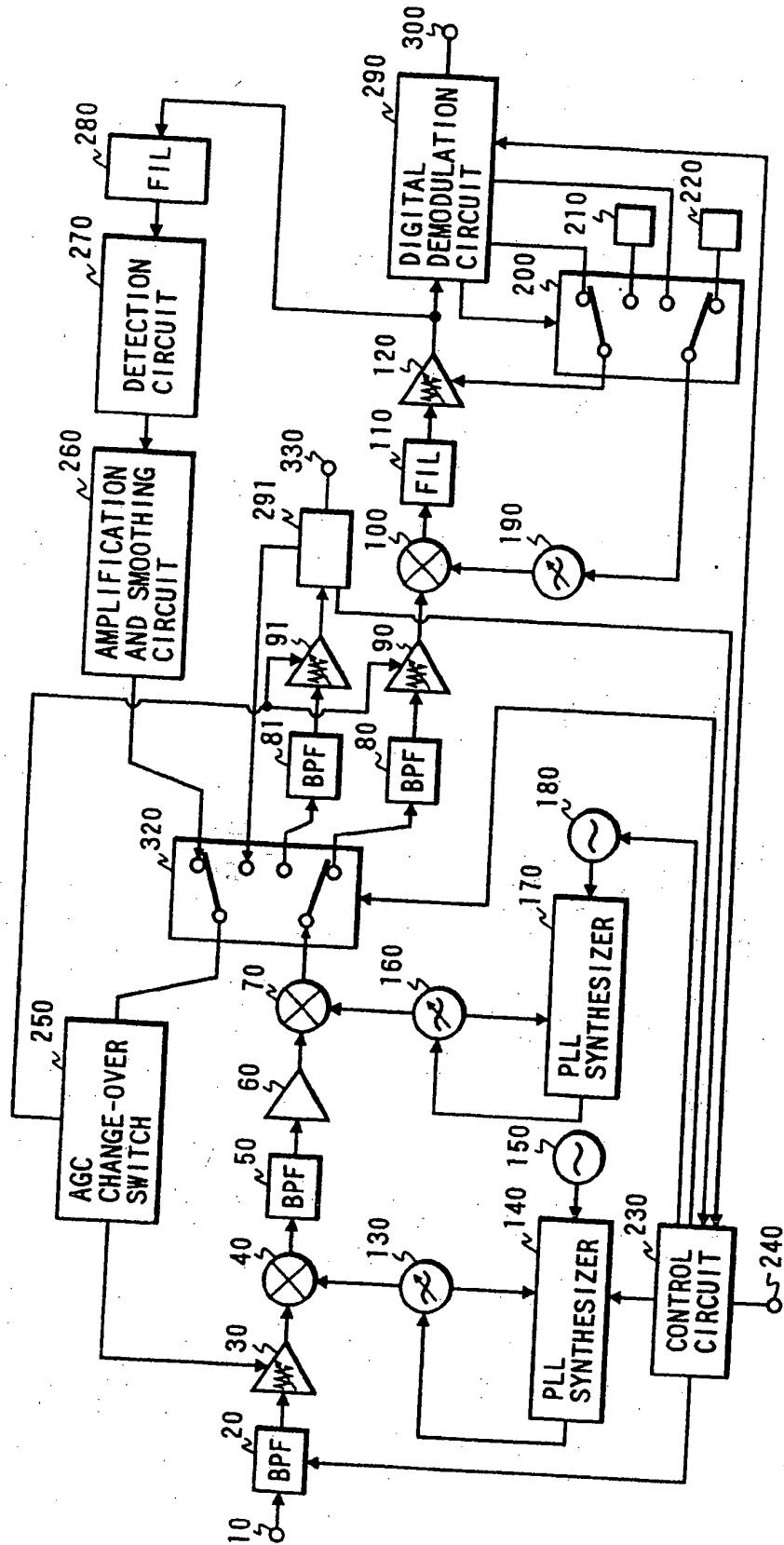
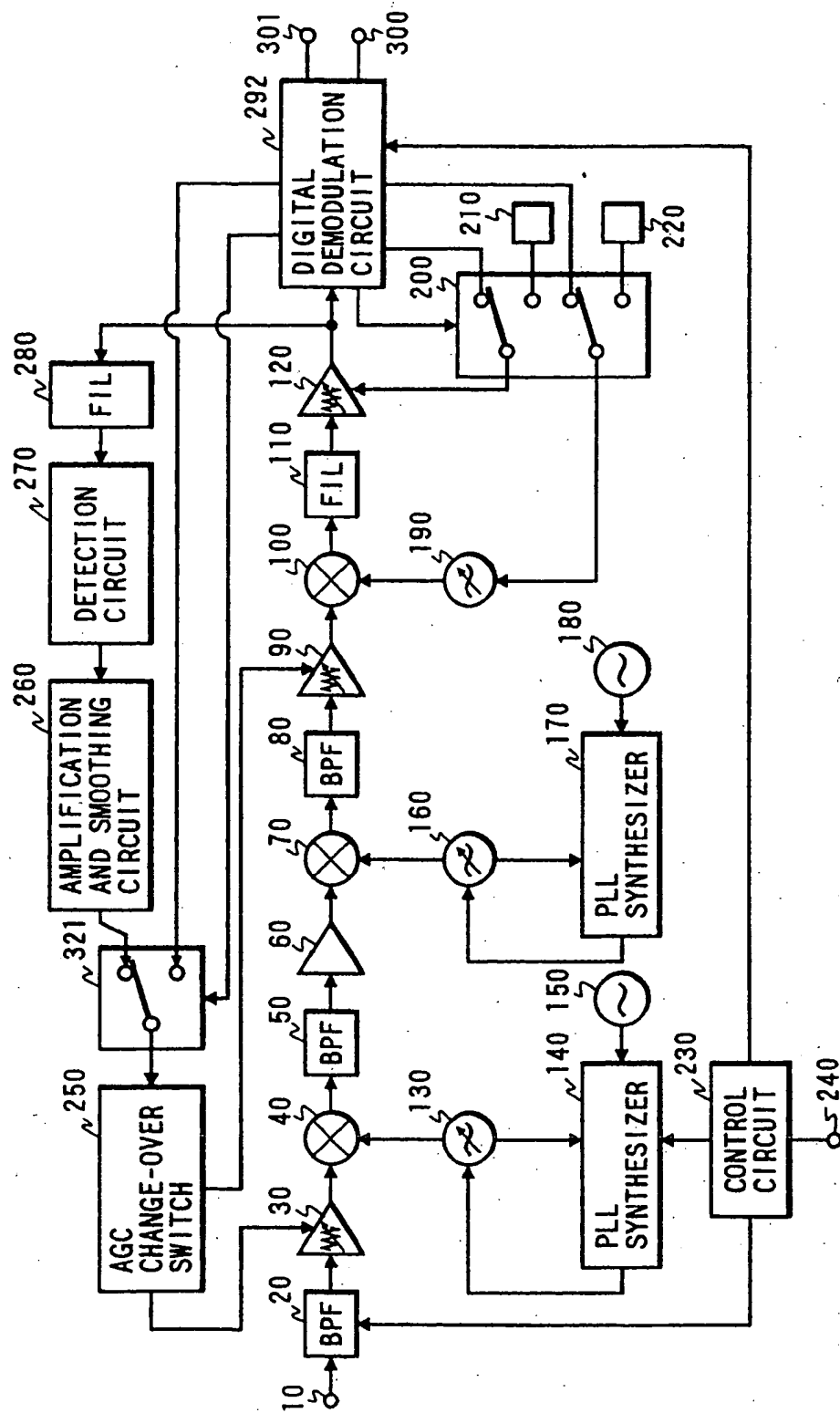
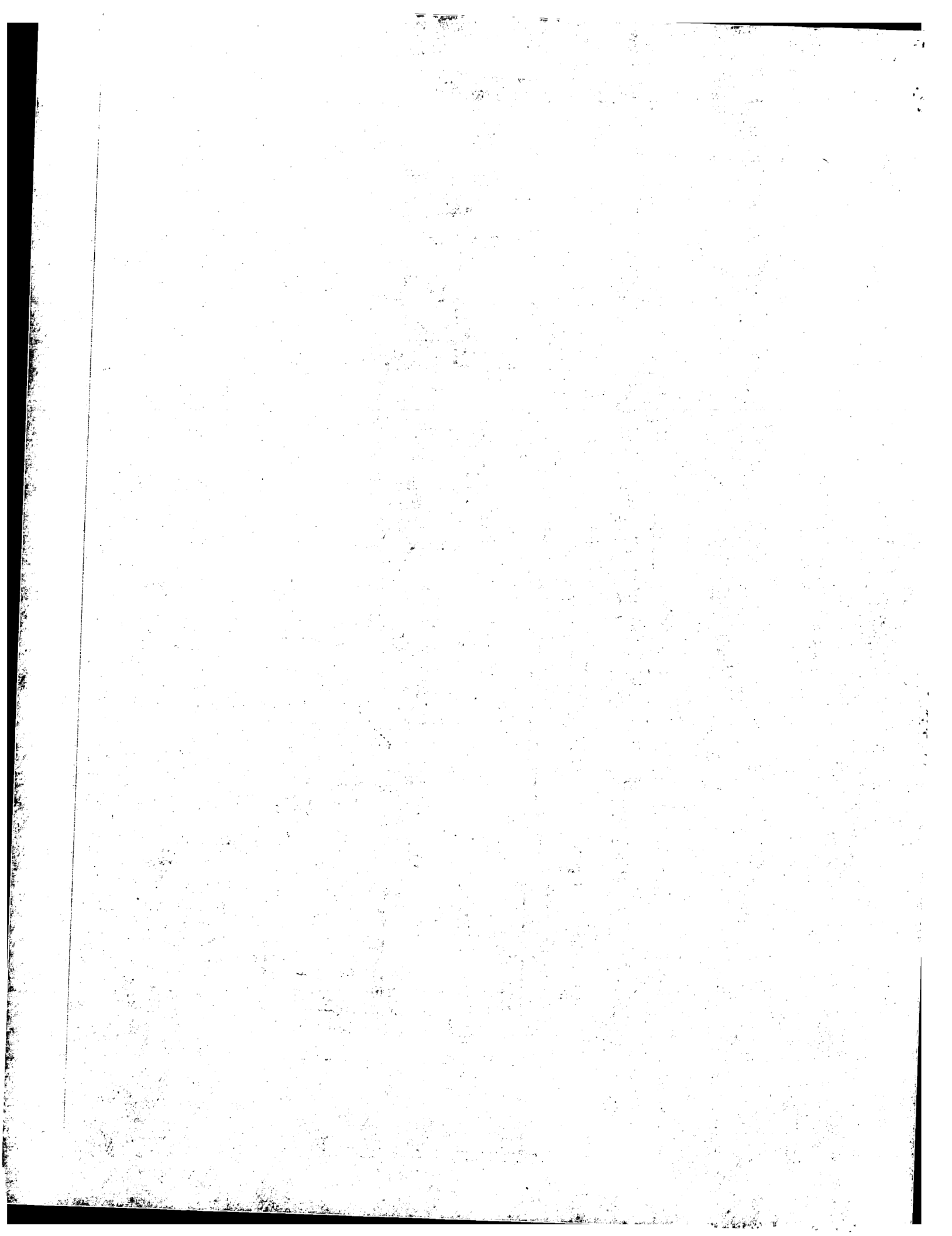


FIG. 8





(19)



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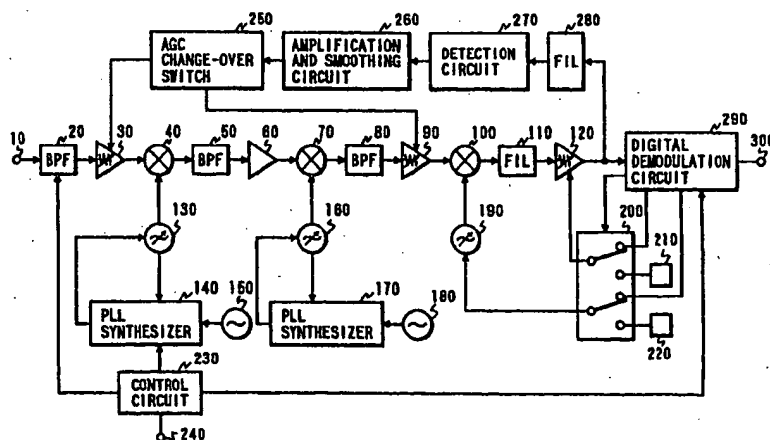
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(54) High definition tv signal receiver

(57) To make it possible to receive a modulated signal which is obtained by suppressing a carrier signal such as a high definition TV signal which is digitally demodulated such as QAM (quadrature amplitude modulation), a receiver of the double super-heterodyne system having the first and second mixers (40) and (70) is a basic constitution. A band pass filter (50) having a flatness in pass band and a small deviation of group delay which will prevent the demodulation of a high definition TV signal from degradation is used as a first intermediate frequency filter. An SAW filter (80) is used as a second

intermediate frequency filter. The third mixer (100) for converting a second intermediate frequency signal to a third intermediate frequency signal in frequency is installed and the frequency of the third intermediate frequency signal to be converted is set to a value lower than the frequency of the second intermediate frequency signal. The demodulator (290) for a high definition TV signal is installed so as to demodulate a high definition TV signal included in the third intermediate frequency signal.

FIG. 1



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DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
A	WO-A-90 04893 (THOMSON-CSF) * page 29, line 26 - page 36, line 27 *	1	H04N5/44 H04N5/46 H04N5/52
A	US-A-5 200 826 (SEONG CH.) * the whole document *	1	
A	EP-A-0 573 247 (MATSUSHITA ELECTRIC INDUSTRIAL CO. LTD.) * column 14, line 56 - column 16, line 33	1,2	
A	EP-A-0 574 273 (KABUSHIKA KAISHA TOSHIBA) * the whole document *	1,2	
A	EP-A-0 574 901 (KABUSHIKI KAISHA TOSHIBA) * the whole document *	1,2	
A	DE-A-31 08 901 (WILHELM S.) * the whole document *	4	
A	EP-A-0 527 289 (ROHDE & SCHWARZ GMBH & CO. KG) * the whole document *	1	
A	WO-A-93 19543 (SCIENTIFIC-ATLANTA INC.) * the whole document *	1	
A	WO-A-93 16553 (GENERAL ELECTRIC COMPANY) * the whole document *	1	
A	IEEE TRANSACTIONS ON CONSUMER ELECTRONICS, vol. 36, no. 3, 30 August 1990, NEW YORK US, pages 407-413, XP000126868 MCGINN M.: "AN ADVANCED I.F. AMPLIFIER & AFT SYSTEM SUITABLE FOR HDTV" * page 409, left-hand column, line 1 - line 20 *	1,6	
The present search report has been drawn up for all claims			TECHNICAL FIELDS SEARCHED (Int.Cl.6)
			H04N
Place of search	Date of completion of the search	Examiner	
THE HAGUE	24 April 1996	Verschelden, J	
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A	US-A-5 283 653 (CITTA R.) * column 2, line 42 - line 44 * -----	1,6	
			TECHNICAL FIELDS SEARCHED (Int.Cl.6)
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 24 April 1996	Examiner Verschelden, J
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